Si87xx LED Emulator Input Isolator Evaluation Board User's Guide

1. Introduction

The Si87xx evaluation board allows designers to evaluate Silicon Lab's family of CMOS based LED Emulator Input isolators. The Si87xx isolators are pin-compatible, single-channel, drop-in replacements for popular optocouplers with data rates up to 15 Mbps. These devices isolate high-speed signals and offer performance, reliability, and flexibility advantages not available with optocoupler solutions. The Si87xx series is based on Silicon Labs' proprietary CMOS isolation technology for low-power and high-speed operation and are resistant to the wear-out effects found in optocouplers that degrade performance with increasing temperature, forward current, and device age. As a result, the Si87xx series offer longer service life and dramatically higher reliability compared to optocouplers. Ordering options for the family include open collector output with or without integrated pull-up resistor or with an output enable pin. The evaluation kit consists of four separately orderable boards with each board featuring either the DIP8, SOIC8, SDIP6, or LGA8 package. For more information on configuring the isolator itself, see the Si87xx product data sheet and as well as application note "AN681: Using the Si87xx LED Emulator Input Family of Isolators".

1.1. Kit Contents

The Si87xx Evaluation Kit contains the following items:

- Si87xx based evaluation board as shown in Figures 1 through 4.
- Si87xx LED Emulator Input isolator (installed on the evaluation board)
  - Si8710 (DIP8, SDIP6)
  - Si8712 (SOIC8, LGA8)

Figure 1. Si87xx DIP8 Evaluation Board Overview

Figure 2. Si87xx SOIC8 Evaluation Board Overview

Figure 3. Si87xx SDIP6 Evaluation Board Overview

Figure 4. Si87xx LGA8 Evaluation Board Overview

2. Required Equipment

The following equipment is required to demonstrate the evaluation board:

- 1 digital multimeter
- 2 multimeter test leads (red and black)
- 1 oscilloscope (Tektronix TDS 2024B or equivalent)
- 1 BNC splitter
- 3 coaxial cables
- 1 dc power supply (HP6024A, 30 V dc, 0–100 mA or equivalent)
- 2 BNC to clip converters (red and black)
- 2 Banana to clip wires (red and black)
- 1 Clip to Clip wire (any color)
- 1 function generator (Agilent 33220A, 20 MHz or equivalent)
- Si87xx Evaluation Board (board under test)
- Si87xx LED Emulator Input Evaluation Board User's Guide (this document)

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Si87xx-EVB

3. Hardware Overview and Demo

Figure 5 illustrates the connection diagram to demonstrate the Si87xx-DIP8 EVB. The other footprint boards demonstrate in a similar fashion. This demo transmits a 500 kHz (5 V peak, 50 percent duty cycle) square wave through the isolator to its output (Vo). In this example, VDD is powered by a 5 V supply. Figure 6 shows a scope shot of CH1 (input) and CH2 (output). Note that if a user wants to evaluate an LED Emulator Input isolator other than the ones pre-populated, this can be accomplished by removing the installed device and replacing it with the desired footprint-compatible isolator device.
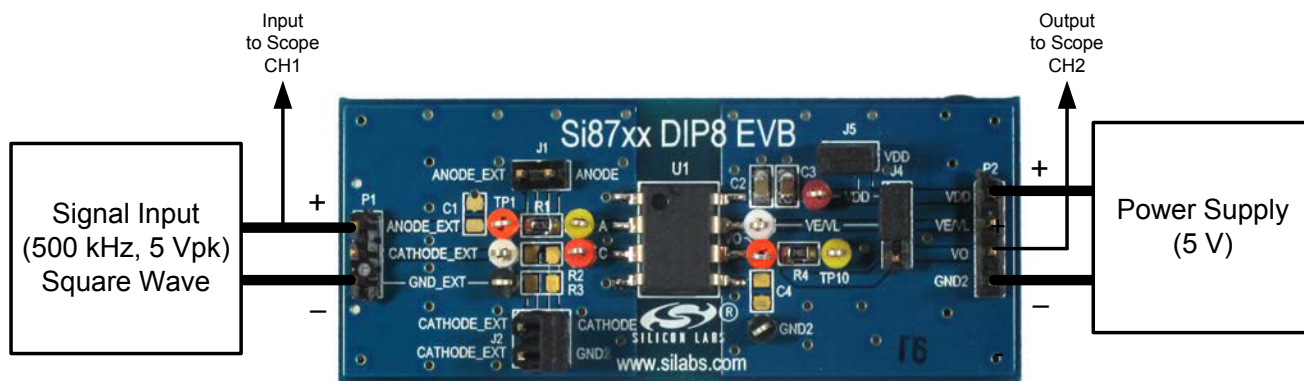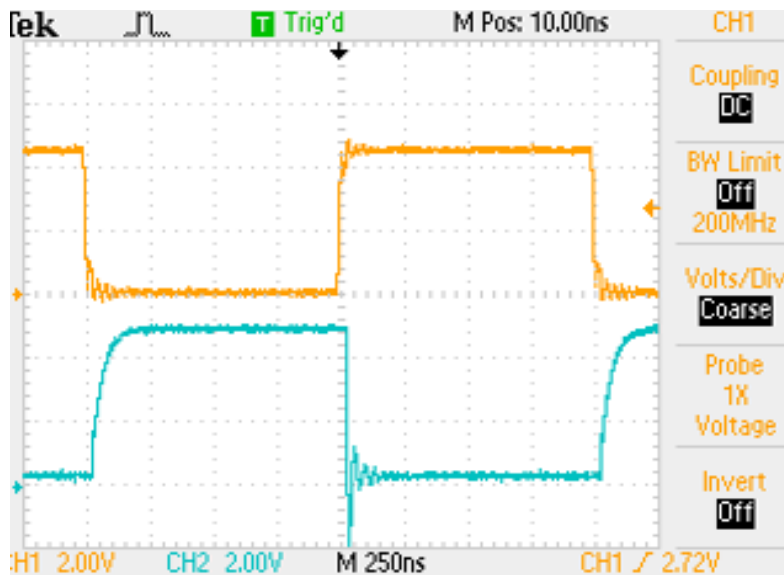

Figure 5. Summary Diagram and Test Setup

Figure 6. Oscilloscope Display of Input and Output

3.1. Board Jumper Settings

To run the demo, follow the instructions below. Review Figure 5 and Figures 11 through 14 if necessary.

1. If demonstrating the SOIC8 or LGA8 EVB featuring the Si8712 (Si8710 for DIP8), ensure that J2, J4, and J5 are installed as shown in Figure 1, 2, or 4.
2. If demonstrating the SDIP6 EVB featuring the Si8710, ensure that J2 and J3 are installed as shown in Figure 3.

3.2. DC Supply Configuration

1. Turn OFF the dc power supply and ensure that the output voltage is set to its lowest output voltage.
2. Connect the banana ends of the black and red banana to clip terminated wires to the outputs of the dc supply.
3. Then, connect the clip end of the red and black banana to clip wires to P2. The red wire goes to Pin1. The black wire goes to Pin4.
4. Turn ON the dc power supply.
5. Adjust the dc power supply to provide 5 V on its output.
6. Ensure that the current draw is less than 25 mA. If it is larger, this indicates that either the board or Si87xx has been damaged or the supply is connected backwards.

3.3. Wave Form Generator

1. Turn ON the arbitrary waveform generator with the output disengaged.
2. Adjust its output to provide a 500 kHz, 0 to 5 V peak square wave (50 percent duty cycle) to its output.
3. Split the output of the generator with a BNC splitter.
4. From the BNC splitter, connect a coaxial cable to CH1 of the scope. This will be the input.
5. Connect a second coaxial cable to the BNC splitter, and connect a BNC-to-clip converter to the end of the coaxial cable.
6. From here, connect the clip end of the BNC-to-clip converter to P1, Pin1 (red wire here) and Pin3 (black wire here). The positive terminal is Pin1 on P1.
7. Connect one end of a third coaxial cable to a BNC-to-clip converter (note that a scope probe can be used here instead).
8. From here, connect the clip end of the BNC-to-clip converter to P2, Pin3 (red wire here) and Pin4 (black wire here). Vo is on P2 Pin3.
9. Connect the other end of the coaxial cable to CH2 of the oscilloscope. This will be the output.
10. Engage the output of the waveform generator.

3.4. Oscilloscope Setup

1. Turn ON the oscilloscope.
2. Set the scope to Trigger on CH1 and adjust the trigger level to 1 V minimum.
3. Set CH1and CH2 to 2 V per division.
4. Adjust the seconds/division setting to 250 ns/division.
5. Adjust the level indicator for all channels to properly view each channel as shown in Figure 6.

A 500 kHz square wave should display on Channel 1 of the scope for the input and an inverted 5 V version of this square wave should display the output on Channel 2, as shown in Figure 6. This concludes the basic demo. For more advanced demos, see the following sections.

3.5. Adjusting Input Signal Frequency and VDD

Now is a good time to explore some additional functionality of the board. From here the user can do the following:

1. Slowly adjust VDD down to 3 V and up to 30 V. Then, take the VDD voltage below 2.8 V. Once below 2.8 V, it can be seen that the Si87xx's UVLO turns on. In this condition, the output should turn off and is pulled to VDD in which case the square wave disappears.

2. Next, adjust the supply back to 5 V.

3. Another dial the user can adjust is the frequency dial on the square wave generator. Turn this dial from tens of Hz up to 15 MHz and observe the scope output.

Note: To alter the output drive strength, R4 can be adjusted. Feel free to vary the 348 Ω (the default board setting) R4 to several kΩ. Changing this value alters the rise/fall times at the expense or benefit of power consumption. Consult the product data sheet as higher value resistors will not accommodate full 30 V operation.

3.6. Enable Test (DIP8, SOIC8, and LGA8 Boards Only)

The next test demonstrates the ENABLE function of the Si8712. To perform this test:

1. Remove the shunt on J4.

2. Connect a clip-to-clip wire from P2, Pin2 (VE/VL) to P2, Pin4 (GND2).

3. The output should be pulled to VDD and the square wave turned off.

4. To resume normal operation, remove the clip-to-clip wire on P2, and reinstall the shunt on J4 (position 1-2).

3.7. Using the Internal Pull-Up Resistor (DIP8, SOIC8, and LGA8 Boards Only)

To use the internal Pull-up resistor, the user will need to:

1. Replace the default device with a Si8711.

2. Remove J5.

3. Move the shunt on J4 to position 2–3.

4. Any of the tests described above can now be repeated.

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4. Open Loop POL Evaluation Board

The power and jumper connections descriptions are summarized here:

- P1   External input signal connections to drive the LED Emulator.
- P2   External output signal connections.
- J1   Jumper when installed used to accommodate common-anode drive.
- J2   Jumper when installed used to accommodate common-cathode drive.
- J3, J5   Jumper used to connect external pull-up resistor R4.
- J4   Jumper used to tie the enable pin to VDD and activate the output of the Si8712; the jumper can also be used activate the internal pull-up resistor on the Si8711.

4.1. Voltage and Current Sense Test Points

The Si87xx evaluation board has several test points. These test points correspond to the respective pins on the Si87xx integrated circuits as well as other useful inspection points. See Figures 7 through 10 for a silkscreen overview. See schematics in Figures 11 through 14 for more details.
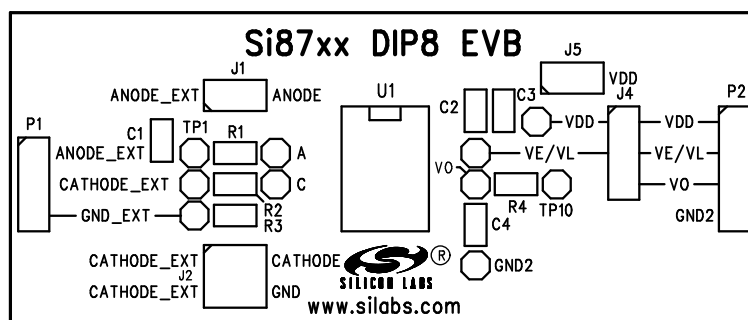
Figure 7. Si87xx DIP8 Evaluation Board Silkscreen
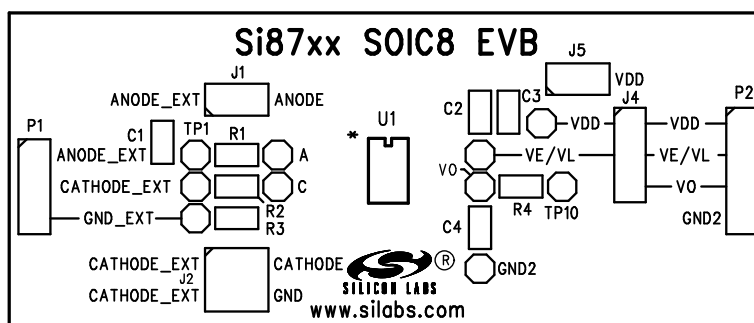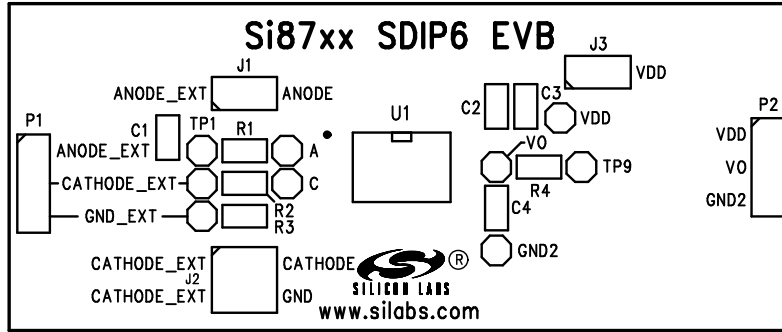

Figure 8. Si87xx SOIC8 Evaluation Board Silkscreen
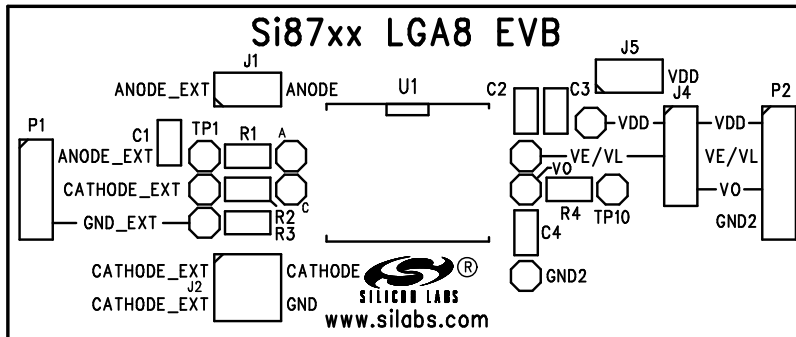
Figure 9. Si87xx SDIP6 Evaluation Board Silkscreen

Figure 10. Si87xx LGA8 Evaluation Board Silkscreen

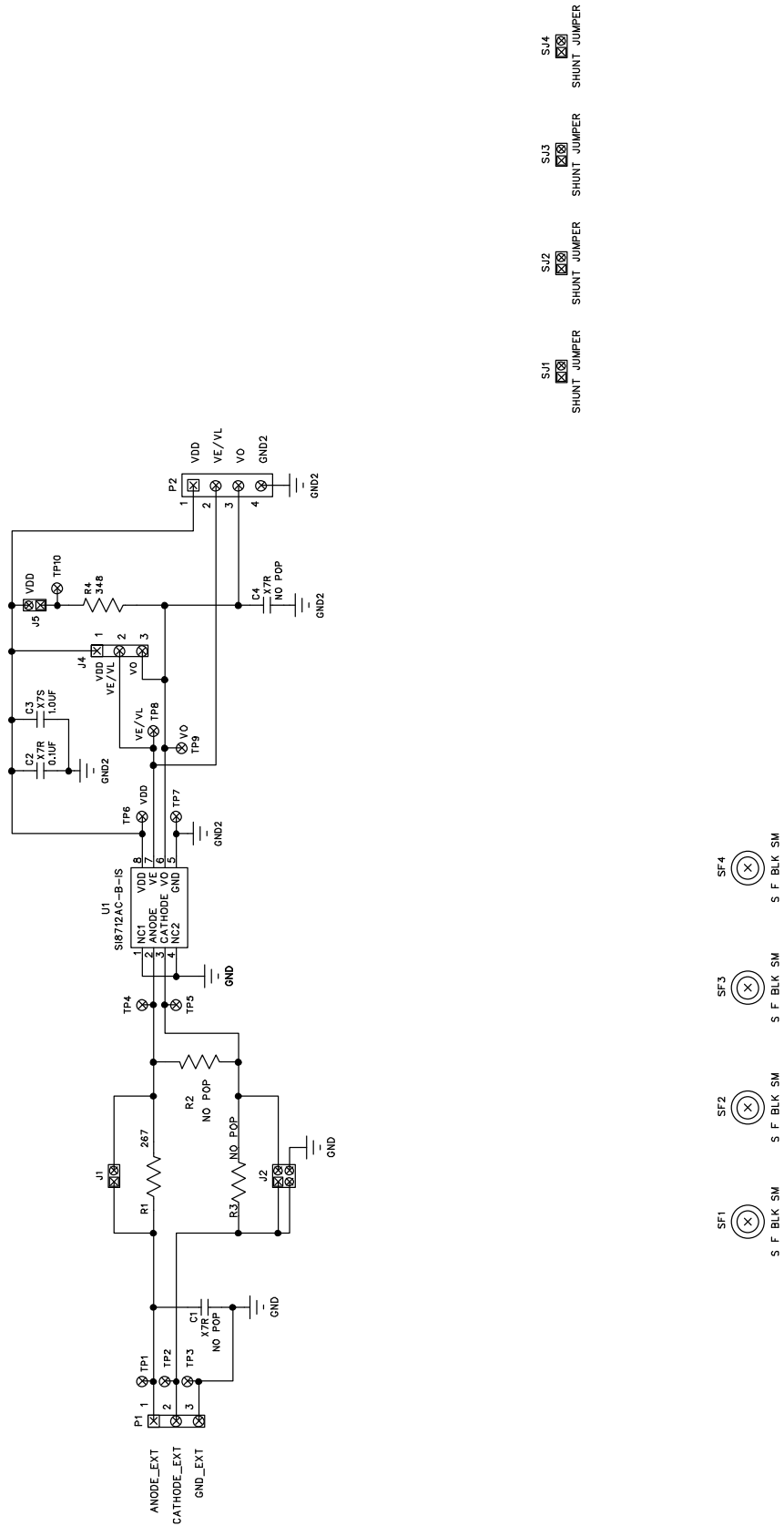## 5. Si87xx Evaluation Board Schematics
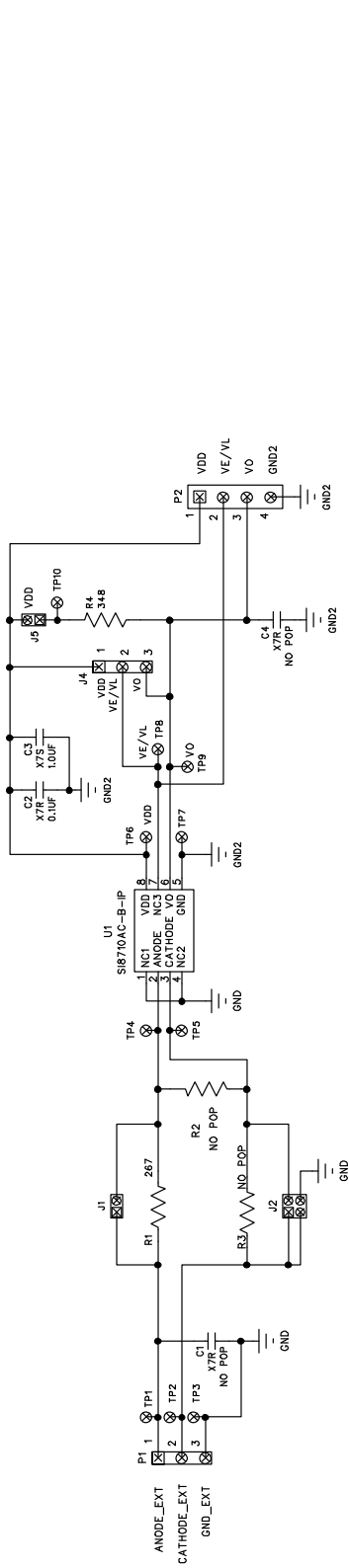
Figure 11. Si87xx DIP8 Evaluation Board Schematic

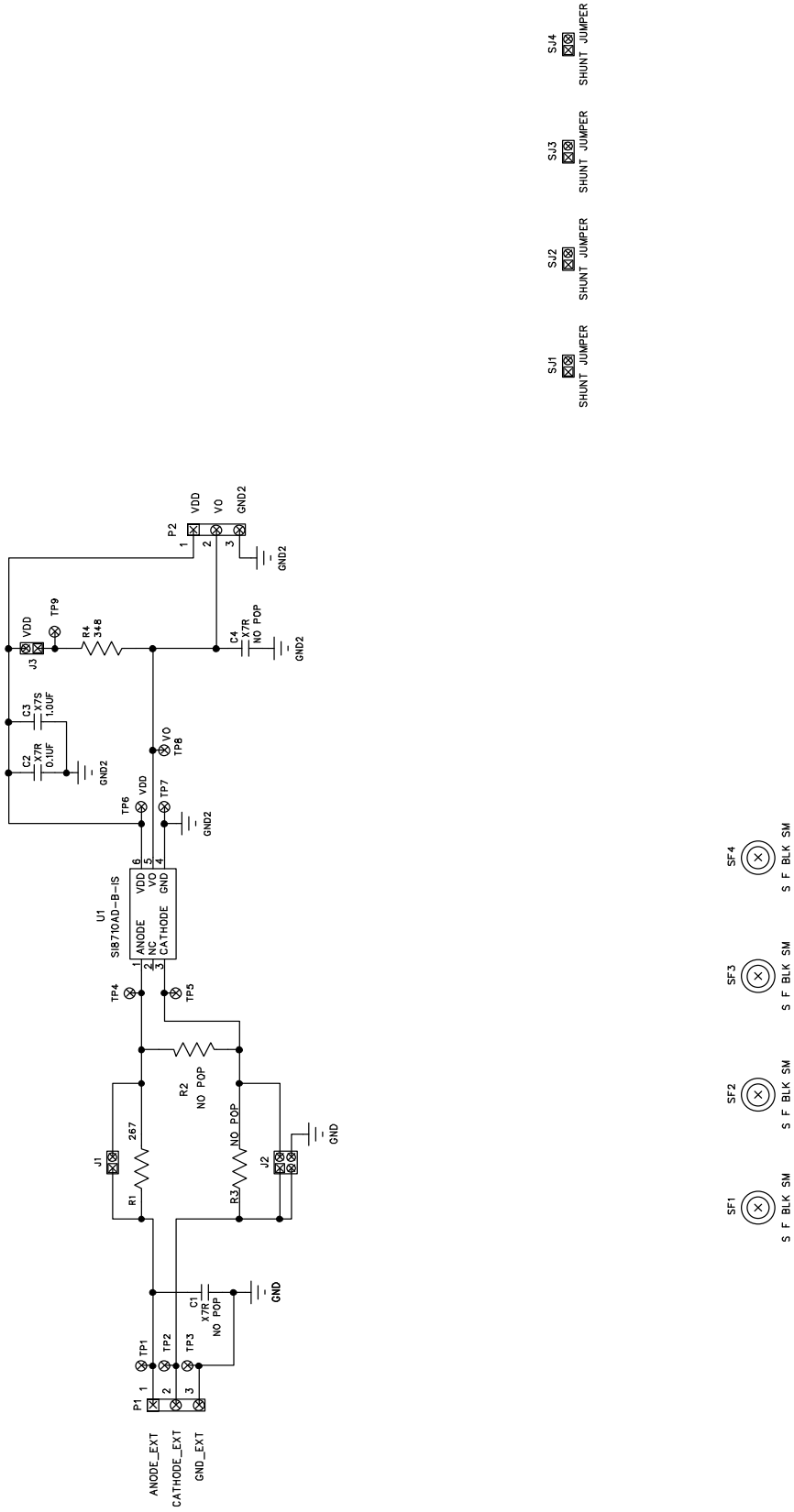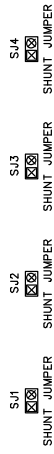**Figure 12. Si87xx SOIC8 Evaluation Board Schematic**

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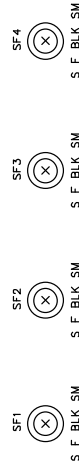
Figure 13. Si87xx SDIP6 Evaluation Board Schematic

Figure 14. Si87xx LGA8 Evaluation Board Schematic
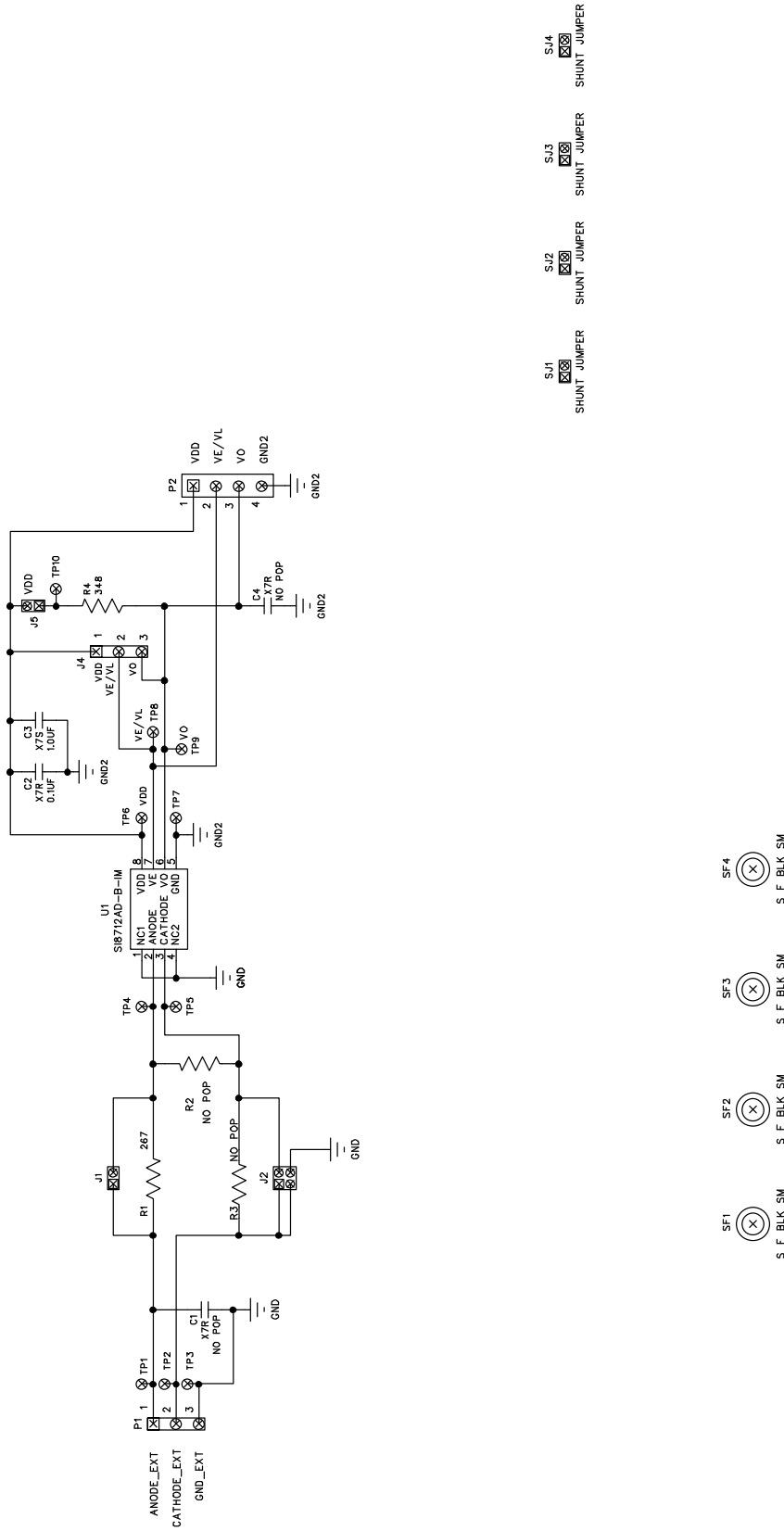
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6. Bill of Materials

Table 1. Si87xx DIP8 Evaluation Board Bill of Materials

Item	Qty	Ref	Part #	Supplier	Description	Value
1	1	C2	311-1140-2-ND	Digikey	Cap, 0.1 µF, X7R, Ceramic, 50 V, 0805, ±10%, or eq, RoHS	0.1 µF
2	1	C3	445-5205-1-ND	Digikey	Cap, 1.0 µF, X7S, Ceramic, 805, 100 V, ±10%, RoHS	1.0 µF
3	2	C1, C4	CAP 0805	Digikey	Cap, No Pop, 0805, or eq, RoHS	No Pop
4	2	J1, J5	S1011E-02-ND	Digikey	Stake Header, 1x2, 0.1"CTR, Gold, or eq, RoHS	1x2 Header
5	2	J4, P1	S1011E-03-ND	Digikey	Stake Header, 1x3, 0.1"ctr, or eq, RoHS	HDR1x3
6	1	P2	S1011E-04-ND	Digikey	Stake Header, 1x4, 0.1"ctrs, or eq, RoHS	HDR1x4
7	1	J2	S2011E-02-ND	Digikey	Stake Header, 2X2, 0.1"ctr, Gold, or eq, RoHS	2x2 Header
8	1	R1	311-267CRCT-ND	Digikey	Res, 267 Ω, SMT, 0805, 1/8 W, ±1%, or eq, RoHS	267
9	1	R4	311-348CRCT-ND	Digikey	Res, 348 Ω, 0805, 1/8 W, ±1%, or eq, RoHS	348
10	2	R2-3	NO POP	Digikey	Res, No Pop, SMT, 0805, or eq, RoHS	No Pop
11	4	SJ1-4	S9001-ND	Digikey	Conn, Jumper Shorting, Tin, or eq, RoHS. (insert after test)	Shunt Jumper
12	1	U1	SI8710AC-B-IP	Silicon Labs	Isolator, 3.75 kV Emulator Input, DIP8-GW, RoHS	SI8710AC-B-IP
13	4	SF1-4	SJ5744-0-ND	Digikey	Bumpon Protective, Bumper, Silicone, or eq, RoHS	S F BLK SM
14	10	TP1-10	5002K-ND	Digikey	Test Point, PC Compact, 0.63"D White, or eq, RoHS	5002

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Table 2. Si87xx SOIC8 Evaluation Board Bill of Materials

Item	Qty	Ref	Part #	Supplier	Description	Value
1	1	C2	311-1140-2-ND	Digikey	Cap, 0.1 µF, X7R, Ceramic, 50 V, 0805, ±10%, or eq, RoHS	0.1 µF
2	1	C3	445-5205-1-ND	Digikey	Cap, 1.0 µF, X7S, Ceramic, 805, 100 V, ±10%, RoHS	1.0 µF
3	2	C1, C4	CAP 0805	Digikey	Cap, No Pop, 0805, or eq, RoHS	No Pop
4	2	J1, J5	S1011E-02-ND	Digikey	Stake Header, 1x2, 0.1"Ctr, Gold, or eq, RoHS	1x2 Header
5	2	J4, P1	S1011E-03-ND	Digikey	Stake Header, 1x3, 0.1"Ctr, or eq, RoHS	HDR1x3
6	1	P2	S1011E-04-ND	Digikey	Stake Header, 1x4, 0.1"Ctrs, or eq, RoHS	HDR1x4
7	1	J2	S2011E-02-ND	Digikey	Stake Header, 2x2, 0.1"Ctr, Gold, or eq, RoHS	2x2 Header
8	1	R1	311-267CRCT-ND	Digikey	Res, 267 Ω, SMT, 0805, 1/8 W, ±1%, or eq, RoHS	267
9	1	R4	311-348CRCT-ND	Digikey	Res, 348 Ω, 0805, 1/8 W, ±1%, OR EQ, RoHS	348
10	2	R2-3	NO POP	Digikey	Res, No Pop, SMT, 0805, or eq, RoHS	No Pop
11	4	SJ1-4	S9001-ND	Digikey	Conn, Jumper Shorting, Tin, or eq, RoHS. (insert after test)	Shunt Jumper
12	1	U1	SI8712AC-B-IS	Silicon Labs	3.75 kV LED Emulator Input, Open Collector Output Isolator, SOIC-8, RoHS	Si8712AC-B-IS
13	4	SF1-4	SJ5744-0-ND	Digikey	Bumpon Protective, Bumper, Silicone, or eq, RoHS	S F BLK SM
14	10	TP1-10	5002K-ND	Digikey	Test Point, PC Compact, 0.63"D white, or eq, RoHS	5002

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Table 3. Si87xx SDIP6 Evaluation Board Bill of Materials

Item	Qty	Ref	Part #	Supplier	Description	Value
1	1	C2	311-1140-2-ND	Digikey	Cap, 0.1 µF, X7R, Ceramic, 50 V, 0805, ±10%, or eq, RoHS	0.1 µF
2	1	C3	445-5205-1-ND	Digikey	Cap, 1.0 µF, X7S, Ceramic, 805, 100 V, ±10%, RoHS	1.0 µF
3	2	C1, C4	CAP 0805	Digikey	Cap, No Pop, 0805, or eq, RoHS	No Pop
4	2	J1, J3	S1011E-02-ND	Digikey	Stake Header, 1x2, 0.1"Ctr, Gold, or eq, RoHS	1x2 Header
5	2	P1-2	S1011E-03-ND	Digikey	Stake Header, 1X3, 0.1"CTR, OR EQ, RoHS	HDR1X3
6	1	J2	S2011E-02-ND	Digikey	Stake Header, 2x2, 0.1"Ctr, Gold, or eq, RoHS	2x2 Header
7	1	R1	311-267CRCT-ND	Digikey	Res, 267 Ω, SMT, 0805,1/8 W, ±1%, or eq, RoHS	267
8	1	R4	311-348CRCT-ND	Digikey	Res, 348 Ω, 0805, 1/8W, ±1%, or eq, RoHS	348
9	2	R2-3	NO POP	Digikey	Res, No Pop, SMT, 0805, or eq, RoHS	No Pop
10	4	SJ1-4	S9001-ND	Digikey	Conn, Jumper Shorting, Tin, or eq, RoHS. (insert after test)	Shunt Jumper
11	1	U1	SI8710AD-B-IS	Silicon Labs	Isolator, 5 kV emulator Input, SDIP6, RoHS	Si8710AD-B-IS
12	4	SF1-4	SJ5744-0-ND	Digikey	Bumpon Protective, Bumper, Silicone, or eq, RoHS	S F BLK SM
13	9	TP1-9	5002K-ND	Digikey	Test Point, PC Compact, 0.63"D White, or eq, RoHS	5002

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Table 4. Si87xx LGA8 Evaluation Board Bill of Materials

Item	Qty	Ref	Part #	Supplier	Description	Value
1	1	C2	311-1140-2-ND	Digikey	Cap, 0.1 µF, X7R, Ceramic, 50 V, 0805, ±10%, or eq, RoHS	0.1 µF
2	1	C3	445-5205-1-ND	Digikey	Cap, 1.0 µF, X7S, Ceramic, 805, 100 V, ±10%, RoHS	1.0 µF
3	2	C1, C4	CAP 0805	Digikey	Cap, No Pop, 0805, or eq, RoHS	No Pop
4	2	J1, J5	S1011E-02-ND	Digikey	Stake Header, 1x2, 0.1"Ctr, Gold, or eq, RoHS	1x2 Header
5	2	J4, P1	S1011E-03-ND	Digikey	Stake Header, 1x3, 0.1"CTR, or eq, RoHS	HDR1x3
6	1	P2	S1011E-04-ND	Digikey	Stake Header, 1x4, 0.1"Ctrs, or eq, RoHS	HDR1x4
7	1	J2	S2011E-02-ND	Digikey	Stake Header, 2x2, 0.1"CTR, Gold, or eq, RoHS	2x2 Header
8	1	R1	311-267CRCT-ND	Digikey	Res, 267 Ω, SMT, 0805, 1/8 W, ±1%, or eq, RoHS	267
9	1	R4	311-348CRCT-ND	Digikey	Res, 348 Ω, 0805, 1/8 W, ±1%, or eq, RoHS	348
10	2	R2-3	NO POP	Digikey	Res, No Pop, SMT, 0805, or eq, RoHS	No Pop
11	4	SJ1-4	S9001-ND	Digikey	Conn, Jumper Shorting, Tin, or eq, RoHS. (insert after test)	Shunt Jumper
12	1	U1	SI8712AD-B-IM	Silicon Labs	Isolator, 5 kV LED Emulator Input, LGA8, RoHS	Si8712AD-B-IM
13	4	SF1-4	SJ5744-0-ND	Digikey	Bumpon Protective, Bumper, Silicone, or eq, RoHS	S F BLK SM
14	10	TP1-10	5002K-ND	Digikey	Test Point, PC Compact, 0.63"D White, or eq, RoHS	5002

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7. Ordering Guide

Table 5. Si87xx Evaluation Board Ordering Guide

| Ordering Part Number (OPN)	Description
Si87xxDIP8-KIT	Si87xx Isolator Evaluation Board Kit featuring DIP8 Package
Si87xxSOIC8-KIT	Si87xx Isolator Evaluation Board Kit featuring SOIC8 Package
Si87xxSDIP6-KIT	Si87xx Isolator Evaluation Board Kit featuring SDIP6 Package
Si87xxLGA8-KIT	Si87xx Isolator Evaluation Board Kit featuring LGA8 Package

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Si87xx-EVB

DOCUMENT CHANGE LIST

Revision 0.1 to Revision 0.2

- Updated schematics in Figures 11, 12, 13, and 14.
- Updated BOM Tables 1, 2, 3, and 4.
- Updated part numbers in "7. Ordering Guide" on page 17.

Revision 0.2 to Revision 0.3

- Updated document throughout to change DIP8 board to use Si8710 instead of Si8712.

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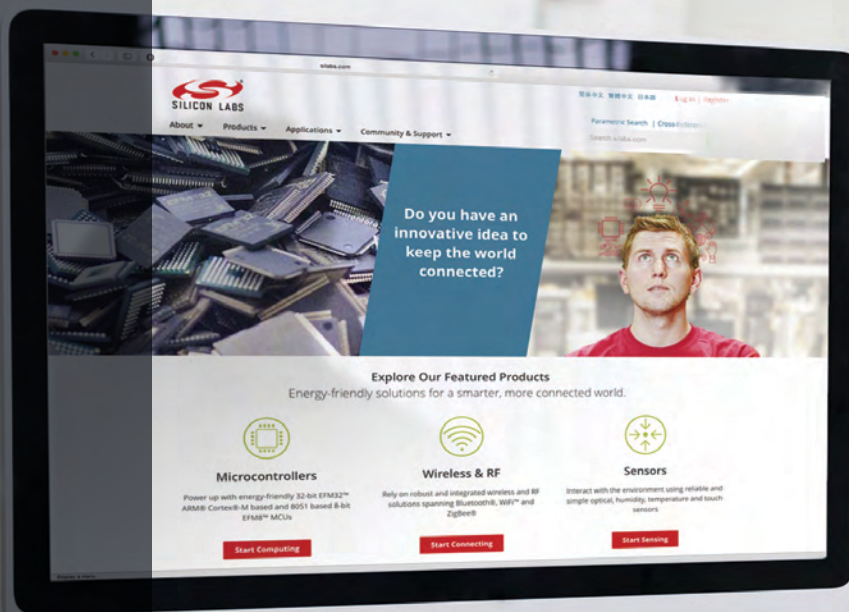
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